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ORIGINAL ARTICLE

Ecological and economic evaluation of varietal resources *Lupinus albus* L. in Ukraine

V.A. Mazur, K.V. Mazur, H.V. Pantsyreva, O.O. Alekseev

Vinnytsia National Agrarian University, Vinnytsia, Soniaczna St., Ukraine. E-mail: apantsyreva@ukr.net

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Leguminous crops that are studied are strategically needed high protein crops of modern crop production, and economic and bioenergetic valuation of their breeding efficiency is long-range and important issue nowadays. In present-day socioeconomic conditions one of the main problems of agriculture economic sector of Ukraine remains essential increasing and stabilization leguminous crops production, that are the main source of balanced in amino acid composition and content of eco-friendly protein. In the article studied ecological features of the white lupine varieties. The present state of the trends of economic use of lupine has been analyzed and its perspectives have been determined. Established varietal assortment of lupine species listed in the State reyestu and analyzed dynamics by years of their creation. Powered common characteristic white lupine varieties listed in the Register. Investigated the properties of high-quality varieties of white lupine Veresnevii and Makarovskii. As a result of the research could be argued that variety Veresnevii belongs to the middle-high-yield 3.61 t/ha and is moisture and light-and variety Makarovskii-to early ripening yield of 3.23 t/ha and is drought resistant. Both varieties are resistant to the disease of spring frost. Comparison of the obtained results with the characteristics of varieties presented by the originator showed the coincidence of varietal characteristics by all indicators.

Keywords: Lupine white; variety; ecological characteristics; yield; vegetation period; growing zone; direction of use

Introduction

Today, under the difficult economic and environmental conditions, the role of crops with significant biological and economic potential is increasing. Livestock crops play an important role in reducing feed and food protein deficiency, fertility and improving the structure of the soil, among which agronomic perspective is white lupine. With the ability to form symbiotic system nodule bacteria of lupine plants accumulate in the biomass to 400 kg/ha of nitrogen, 70% of which is accounted for symbiotic. But the nitrogen-fixing activity and productivity of white lupine depends on the varietal characteristics of plants and adaptability to environmental conditions.

One of the important means of improving the productivity of crops is the variety. It is through the creation of new varieties that it is possible to increase productivity, quality of grain, resistance of plants to diseases, which will improve the state of the environment and lead to ecologization of agriculture, by 30-70%.

In the countries of the East, lupine is very important as a food culture, and in other countries of the world, for example, in the USA, lupins were first grown for feed or green fertilizer and only much later began to dominate the grain trend. At the same time, growing lupine for grain in some countries reaches almost 100%. In Ukraine, lupine has not yet acquired such a strategic and important value, and it is grown mainly in certain regions only on grain. However, at the expense of lupine, the problem of supplying feed protein in the livestock sector in Ukraine is still not possible. At the same time, in Australia, the USA, China, Brazil, Italy and other countries, the production of lupine grain and its efficient use in livestock production are growing at a high pace.

Therefore, the problems of lupine production in our country, the preservation of the varietal resources of this culture and the conquest of one of the main protein regions of the world-must be solved on the basis of scientifically substantiated formation of the varietal resources of this extremely valuable culture, with further study of their suitability for distribution in Ukraine.

The purpose of the research was to analyze the ecological and economic-biological characteristics of the main varieties of white lupine and compare it with the results of its own research in the Right-Bank Forest-Steppe zone in Ukraine.

Materials and methods

The field research was conducted on the experimental field “Agronomichne” of Vinnytsia National Agrarian University that was sown with white lupine, village Agronomichne, Vinnitsa district, Vinnytsia region. White lupine variety Veresnevyi was selected as the material for the study.

Materials for researches were white lupine varieties, entered in the register of plant varieties of Ukraine and recommended for distribution. There was applied the technology of growing white lupine varieties that was conventional for the Forest-Steppe zone of Ukraine and involved pre-sowing seed treatment with the bacterial agent Rhizohumin combined with the growth stimulator Emistym C and foliar nutrition with Emistym C. The registered area was 25 m^2. Replication was five-time. The variants were located systematically in two layers.

The technology of cultivating white lupine varieties commonly used for the Forest Steppe zone in Ukraine and foresees the pre-seed treatment of seeds with the bacterial preparation Risogumin in combination with growth stimulator Emistim C and endocrine feeding by Emistim S. The area of the registration-25 m^2. Repetition-five-time. Placement of options-systematic in two tiers.

Statistical analysis of the experimental data was carried out using the computer program STATICA-6. Validity of the difference of the experimental data regarding the control was determined using Student's t-criterion. The tables and figures show the average data over the years of research.

Results and discussion

Important scientific researchers results in the technology of peas and lupine growing were made by national and foreign scientists A. O. Babych, V. F. Petrychenko, V. A. Mazur, H. V. Pantsyreva, V. G. Myhailov, M. I. Bahmat, M. J. Shevnikov, O. M. Bahmat, V. V. Lyhochvor, K. Novák, B. Furseth etc.

Lupine-moderately thermophilic plant. The most demanding for heat among the representatives of the genus Lupinus L.; white, whose seeds begin to sprout at a temperature of 4-6 °C, and the ladder die at 3-4 °C. The temperature of soil and air affects not only the field similarity, but also on the duration of the interfacial period of the sowing -the ladder. For germination and emergence of ladders, an average daily temperature of 90-150 °C is required. Stacks can withstand frosts to 9 °C. White lupine is characterized by a rapid growth rate, especially in the initial phases. For the formation of vegetative organs of lupine, the optimum temperature is 14 ± 16 °C, and in the case of bloom 16 ± 20 °C. For mature white lupine seeds of modern varieties you need a sum of positive temperatures from 1300 to 1800 °C.

White lupine is a plant of a long daylight, so shading carry bad. The plant is thermophilic, which is clearly manifested in it positive heliotropism-the properties to turn their leaves perpendicularly sunlight throughout the daylight. Lack of light leads to the increased growth of the stems, their stretching, the weak development of the root system, poor flowering, but as a consequence of weak fruiting. Exist the idea that light intensity is a leading factor affecting yield of seed.

In the early stages of growth and development, lupine better tolerates shading than ending. Critical period is the formation of beans and maturation of seeds. Reducing the length of the light day delays the onset of the flowering phase. The most responsive to the change in the length of the day is lupine narrow-necked and slightly weaker-white.

Plants of white lupine are very demanding for moisture, transpirational the coefficient fluctuates within 600-700. However, this plant is resistant to short-term drought, especially in the second half of the vegetation, when it is not coincides with critical periods. The most sensitive to this kind of shortage moisture during periods of germination of seeds and formation on generative plants organs: starting from the budding phase-the entire period of flowering to the formation phase beans.

For germination of white lupine seeds, a lot of moisture is required-170%. However, the excessive amount of moisture for lupine is also unfavorable. In years of excessive moisture during the growing season of white lupine lengthening, maturation of the seeds is delayed, the damage to the plants increases fungal diseases. Insufficient soil moisture has a more significant effect on grain yields lupine than the green masses, especially when growing on lighter ones the soil, as well as in the beginning of the vegetation, when the root system is still underdeveloped. Each component of the indivisible complex of soil-climatic conditions significantly reflects the growth and development of plants during a certain period time, and eventually the level of productivity of culture.

Of the many species of the genus Lupinus (according to the classification of different authors from several tens to several hundred), in most countries of the world, including Ukraine, only three cultivate: *L. angustifolius* L., *Lupine luteus* L., *Lupine albus* L. On the basis of these species, many varieties (foreign and domestic breeding) are obtained, which are used as a grain, feed culture with different uses.

According to literary sources, all kinds of lupine were brought to this continent by the first settlers from America. After analyzing the works of domestic and world scientists, we described the natural areas of representatives of the genus Lupinus (Table 1).

Table 1. Natural habitats of the representatives of the genus Lupinus and indicators of the minimum temperatures of their natural habitats.

No.	The name of the species	Natural habitat of the species	Minimum temperature, °C
1	*Lupine albus* L.	Australia	-6.6-16.8
2	*Lupine luteus* L.	USA, Canada, Ireland, United Kingdom, Zeland	-3.9-12.3
3	*Lupine angustifolius* L.	Greece, Turkey, Lebanon, Syria, Israel, Western Jordan	-7.8-12.5

According to literary sources, all kinds of lupine were brought to this continent by the first settlers from America. At the end of the twentieth century. The traditional lupine species in Australia have become an integral part of their scientific research.

With little experience in planting this kind of plants, most of them, in the countries of Europe, as well as the USA and Canada, can develop well, endure the cold season, blossom and bear fruit. However, today the issue of the ecological characteristics and economic characteristics mentioned above is not sufficiently studied.

Consequently, the natural possibilities of representatives of the genus Lupinus, plasticity to change their liveliness, highquality by the combination of environmental features characterizes these plants as a source for introducing and enriching the range of leguminous crops in Ukraine.

Biomorphological features and yield of representatives of the genus Lupinus L., which have grain and fodder directions in Ukraine are given in Table 2.

Table 2. Biomorphological features and yield of representatives of the genus Lupinus L., which are grown for grain and forage.

No	The name of the species	Height plants, sm	Color of Flowers	Weight 1000 seed, pcs	Yield
1	*Lupine albus* L.	90-150	white	300-500	3.5-4.2
2	*Lupine luteus* L.	80-150	yellow	140-190	3.0-3.8
3	*Lupine angustifolius* L.	70-150	blue, pink, violet, white	100-155	2.2-2.8

Modern lupine varieties of grain use are characterized not only by high fodder productivity, but also by grain. The highest grain yield can be obtained from white lupine plants. So, this indicator for growing on grain varies within 3.5-4.2 t/ha.

The varied policy of white lupine is based on the domestic assortment. The modern market for all types of lupine is presented only by Ukrainian breeders. The main scientific research institute for the selection of lupine varieties is the National Science Center "Institute of Agriculture" of the National Academy of Sciences of Ukraine.

The produced lupine varieties of the National Research Center of the Institute of Agriculture of the National Academy of Sciences are successfully implementing in production not only in Ukraine but also abroad. So, according to the database of the International Union for the Protection of New Varieties of Plants (UPOV), the white lupine variety Diet is registered in the UK for the purpose of listing in the national catalog.

State variety testing is based on experimental estimations of morphological, biological and valuable economic characteristics of plant varieties, determination of their suitability for use in compliance with ecological, technological principles and accepted research methods.

Analysis of the State Register of White Lupine varieties showed that selection work on the creation of new varieties of lupine in Ukraine is still insufficient. The assortment of lupins is, today, 23 varieties, in particular 11- *L. albus*, 7- *L. luteus* and 5- *L. angustifolius* (Table 3).

Table 3. Registration of lupine varieties over the years (1985-2018).

Crop	Number of registered varieties		
	1985-1999	2000-2004	2005-2018
Lupinus albus L.	3	5	11
Lupinus luteus L.	2	3	7
Lupinus angustifolius L.	0	0	5
Total	5	8	23

In the State Register of Plant Varieties of Ukraine there are the following varieties of lupine of white breeding NSC "Institute of Agriculture of NAAS": Borky, Volodymyr, Veresnevii, Garant, Tuman, Serpnevii, Diet, Lybid, Makarivskii, Schedrii 50 та Chabanskii. All types of white lupine are of an intensive type, resistant to harmful objects, unfavorable environmental factors and are suitable for cultivation in the Forest Steppe and Polissya areas.

For the duration of the growing season, all varieties of white lupine are divided into three groups: fast-moving, early-heeled, and mid-fall (Table 4). In this case, the most varieties of middle-aged (5 varieties).

The direction of use of white lupine varieties is universal (fodder, food) for balance on the amino acid composition of proteins of plant origin in the diet of humans and animals.

Table 4. The types of white lupine included in the State Register of Plant Varieties, suitable for distribution in Ukraine in 2018.

Varieties	Recommended growing area	Direction of use	Group of ripeness	Quality
Veresnevii	Forest Steppe, Polissya	Fodder	middle-aged	high protein
Makarivskii	Forest Steppe, Polissya	Fodder	middle-aged	high protein
Chabanskii	Forest Steppe, Polissya	Fodder	early-heeled	high protein
Volodymyr	Forest Steppe, Polissya	Food, fodder	middle-	medium

			aged	protein
Garant	Forest Steppe, Polissya	Fodder	middle-aged	medium protein
Diet	Forest Steppe, Polissya	Fodder	middle-aged	high protein
Tuman	Polissya	Fodder	early-heeled	medium protein
Schedrii 50	Polissya	Fodder	early-heeled	high protein
Serpnevii	Forest Steppe, Polissya	Fodder	speeds	high protein
Borky	Forest Steppe, Polissya	Food, fodder	speeds	medium protein
Lybid	Forest Steppe, Polissya	Fodder	middle-aged	medium protein

According to the results of the research, the most promising and high-protein in the right-bank forest-steppe are the varieties of September and Makarovsky. These varieties were studied during 2013-2018 at the research field of Vinnitsa National Agrarian University in the village Agronomichne (Table 5).

Table 5. The impact of the variety on the quantitative and environmental performance of white lupine plants, the average for 2013-2018.

Varieties	Vegetation period, days	Productivity, t/ha	Colecting protein, t/ha	Environmental performance resistant to disease
Veresnevii	116	3.61	0.93	middle-aged, wet-and photophilous, resistant to spring frost
Makarivskii	108	3.23	0.81	resistant to disease, early-heeled, drought-proof, resistant to spring frost

The originator of the studied varieties of white lupine gives them such a characteristic.

Lupinus albus variety Veresnevii. Applicant: National Science Center "Institute of Agriculture of the National Academy of Sciences". Distribution zone-Forest Steppe, Polissya. The variety is resistant to diseases, tolerant to anthracnose (created by the method of hybridization of line 170, characterized by field resistance to anthracnosis with Pischevoy variety, followed by improvement of individual selection for a number of economic values and resistance to anthraxase). The grade belongs to the group of middle-aged, moist- and wet - and photophilous, resistant to spring frost.

Lupinus albus variety Makarivskii. Applicant: National Science Center "Institute of Agriculture of the National Academy of Sciences". Distribution zone-Forest Steppe, Polissya. Fusariosis has not exceeded 2-3%, anthracnosis has not been detected in recent years. The grade belongs to the group of early-fallen, resistant to spring frost, drought-proof, resistant to ingrowing and aspiration of grain, suitable for mechanized harvesting.

The length of the growing season in the varieties of Veresnevii and Makarivskii was 116 and 108 days respectively. The maximum level of yield was on the parts of the Veresnevii variety-3.61 t/ha. The smallest yield index-3.23 t/ha was obtained in parts of the Makarivskii variety.

The comparison of the economic and biological characteristics of white lupine varieties found during the study completely coincides with the characteristics declared by the originator.

Conclusion

Consequently, the natural possibilities of representatives of the genus Lupinus, plasticity to change their liveliness, high quality by the combination of environmental features characterizes these plants as a source for introducing and enriching the range of leguminous crops in Ukraine. Studies have shown that the magnitude of the white lupine grain crop is largely influenced by the choice of variety. Thus, the maximum yield index was obtained on plants of lupine white varieties of September and was 3.61 t/ha. The introduction of new livestock feed varieties will increase the deficiency of plant protein in animal rations and, at the same time, increase the soil fertility, improve its physical, chemical and phytosanitary conditions.

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